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TRANSFER PALLET WEIGHING DEVICE
[DISPOSITIF DE PESAGE SUR TRANSPALETTE]

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(54) TRANSFER PALLET WEIGHING DEVICE /i*

(57) Abstract

The weighing device (12) lets one determine and indicate the weight (P) of a load (31) being supported by the transfer pallet.

A force sensor (13) with strain gauges, which functions as a shearing stress sensor, comprises simultaneously the connection member between the top of the hydraulic lifting jack (6) and the frame (3) of the transfer pallet. The force sensor (13) is connected electrically to an electronic processing unit that is combined with some display devices (30) of the measured weight (P).

This device (12) lets one weight the load (31) with sufficient accuracy as soon as the latter is separated from the floor.

The present invention pertains to a weighing device /1 incorporated in a load-handling machine, more particularly a transfer pallet, this device allowing one to determine and indicate the weight of the load supported by the transfer pallet.

Some load-handling machines are already known, such as hand-operated transfer pallets and fork lift trucks equipped with weighing devices that let one know immediately the weight of the raised and transported loads without the assistance of an attached scale, therefore with an appreciable gain with respect to handling operations, time, space and cost.

As an example, one could mention in this respect the French patent No. 8,817,038/2639931 of the same inventor, which describes a handling machine equipped with a weighing device, and more particularly a manual transfer pallet that includes several weight

* Number in the margin indicates pagination in the foreign text.

sensors arranged beneath the load receiver, as well as a level correction system and electronics that process the information coming from the weight sensors by making a correction as a function of the inclination o the machine. Such a unit allows very precise weighing, but on the other hand it is complex and expensive.

However, there is a need for transfer pallets equipped with a less precise weighing device, and therefore simpler and less expensive, which nevertheless give a significantly close indication of weight (by nearly 5 kg for example, for a load that can reach two tons at most) and that meets the majority of the demands encountered in practice.

Another weighing principle, applicable to load-handling machines such as transfer pallets, traditionally provided with a hydraulic circuit that powers a lifting jack, consists in providing an oil pressure sensor at a point of the hydraulic circuit or directly on the hydraulic lifting jack. Such a principle, mentioned for example in the French patent application No. 9213194/2697629, includes many /2 disadvantages:

- The pressure sensor does not furnish a weight indication directly;
- As a function of variations of the temperature of the oil the viscosity of this oil and its pressure are themselves variable, which makes the determinations of weight by this method imprecise and uncertain;

- The oil leaks and wear of the oil pump modify over time the characteristics of the hydraulic circuit, and also lead to false readings of the weight determinations. In case the pump of the hydraulic circuit is replaced the weighing device must be recalibrated;
- The wear of the mechanical parts of the transfer pallet also leads to a variation over time of the pressure needed for lifting a given load, and hence a deviation of the measurements over time;
- The weighing device is generally added to an existing transfer pallet, and it includes some projecting parts, especially of the parts that extend beyond the jack, such as tubes or wires, which are exposed to the danger of shocks and deterioration during use of the transfer pallet;
- In order that the weighing device can function under the best measurement conditions, the lifting jack must be positioned in high position.

The present invention aims to overcome these disadvantages in the unit by supplying a weighing device installed on the transfer pallet, with simple structure and not very expensive, and of sufficient precision that is not based on measurement of the oil pressure, which will eliminate all the aforementioned problems, the proposed weighing device being in addition compact and perfectly integrated with the transfer pallet structure.

For this purpose the invention essentially has as its goal a /3
weighing device on a transfer pallet, which includes in the known manner some longitudinal bars or "forks" connected to the rear by a transverse frame, and a hydraulic lift device with a hydraulic jack having an approximately vertical axis, connected to the said frame, the weighing device being characterized in that it includes at least one force sensor with strain gauge, which functions as a shearing stress sensor, which also comprises a connection member between the top of the hydraulic lift jack and the frame, one part of the force sensor being connected mechanically to the top of the hydraulic lift jack and another part of the force sensor being connected mechanically to the frame, this force sensor being also connected electrically to an electronic processing unit combined with measured weight display devices.

Thus, the weighing device that is the goal of the invention is based on a mechanical principle, and not a hydraulic principle. Moreover, this weighing device can make do with a single sensor, which supplies directly the weight of the load, and which yields a valid indication as soon as the load is separated from the floor. The sensor is perfectly integrated with the structure of the transfer pallet, since it is inserted between the top of the lift jack and the frame, and it does not contain any projecting part. Thus, this sensor is not subject to shocks. All the problems of imprecision due to the oil leaks, variation of the oil temperature and to wear are

eliminated. In case of replacement of the hydraulic circuit pump it is not necessary to recalibrate the weighing device. The principle of this weighing device lets one also avoid problems of displacement of the center of gravity of the load on the forks of the transfer pallet. Sufficient precision and reliability of measurement are thus ensured.

According to a preferred form of implementation of the /4
invention, the rear part of the force sensor, shaped as a unit oriented from rear to front, is connected by a ball and socket joint to the top of the hydraulic lift jack, while the front part of the force sensor is integrated with the frame of the transfer pallet. Advantageously, some devices are provided for the height adjustment of the rear part of the force sensor, with respect to the top of the hydraulic lift jack. In a particular mode of execution the rear part of the force sensor is traversed by an adjusting screw, approximately vertical, whose head turned toward the bottom has a spherical surface, comprising one of the ball and socket joint elements. According to another mode of implementation, the rear part of the force sensor is traversed by an adjusting screw, approximately vertical, whose head turned toward the bottom has a tapered void, against which a ball immobilized at the top of the lift jack rests.

A protective housing covers, advantageously, the rear part of the force sensor and the ball and socket joint connecting this rear part to the top of the hydraulic lift jack; the housing ensures in

particular protection from dust and bad weather. In order to prevent the force sensor from accidentally separating (by being raised up) from the top of the jack, the protective housing can include, laterally and internally, some projecting parts that are engaged in an annular opening provided at the top of the hydraulic lift jack.

According to another characteristic of the invention the force sensor has some strain gauges with a film-type screen arranged in some housings provided on both sides of the sensor, at an intermediate position along its length.

According to another aspect of the invention the electronic /5
processing unit and the display devices, as well as the electric power source required for their operation and for that of the strain gauges, are arranged in the upper part of the frame of the transfer pallet, above the front part of the force sensor. The entire weighing device is thus particularly compact, and entirely integrated with the transfer pallet. The reading of the measured weight, being inscribed on the display devices placed at the top of the frame of the transfer pallet, is particularly convenient for the operator.

According to another possibility, which makes the weighing device according to the invention adaptable to an existing transfer pallet, the force sensor is integrated in a compact unit that also includes the processing electronics, the display devices and the electrical power source, the said unit being equipped so that it can be secured to the part left in the position of the partially

sectioned head of the transfer pallet frame, and to be connected to the top of the lift jack of this transfer pallet.

The electric power source is especially a cell or battery, giving the weighing device the desired autonomy, an easily available disposable cell being particularly suitable.

In another form of implementation the connection member between the top of the lift jack and the transfer pallet frame, the member also comprising the force sensor, is a transverse connection shaft, shaped as a dynamometer shaft with strain gauge. This latter version of the invention is more particularly applicable to a motorized transfer pallet, such as an electric powered transfer pallet.

The invention will be better understood by referring to the description that follows, with reference to the attached schematic drawing that shows, as examples, a few forms of implementation of this weighing device on a transfer pallet: /6

Figure 1 is a side view of a manual transfer pallet equipped with a weighing device in conformity with the invention;

Figure 2 is a plane view from the top of the transfer pallet of figure 1;

Figure 3 is a side view on enlarged scale, partially sectional, which shows details of the weighing device that equips this transfer pallet;

Figure 4 is a partial side view, partially sectional, of a first variant of this weighing device;

Figure 5 is a front view of a second variant;

Figure 6 is a sectional view of this version, along VI-VI of Fig. 5;

Figure 7 shows quite schematically a last variant, applicable to a motorized transfer pallet.

Figures 1 and 2 remind one of the traditional structure of a manual transfer pallet. The latter has a chassis that includes two parallel longitudinal members or "forks" 1 and 2, united at one rear end by a transverse frame **3**. The frame **3** is connected, on the side opposite the longitudinal bars **1** and **2**, to a unit that turns about a vertical axis, and includes two wheels **4**, a shaft **5** and a hydraulic lift jack **6** with approximately vertical axis. The jack **6** rests, at its base, on a transverse plate **7** that is connected by two articulated lift arms **8** and **9** to the frame **3**. Toward the free front ends of the two longitudinal bars **1** and **2** some wheels **10** and **11** are again provided.

The weighing device, designated in its entirety by the reference number **12** and more particularly visible in Fig. 3, includes mainly a force sensor **13** that also comprises the connection member between the top of the hydraulic lift jack **6** and the frame **3**. /7

More particularly the lift jack **6** is extended along its axis, at its top, by a short shank **14** whose upper end forms a hemispherical cup. The rear part of the sensor **13**, shaped as a solid unit oriented from rear to front, is traversed by an approximately vertical screw

15, whose head 16 turned toward the bottom has a hemispherical shape and is supported in the hemispherical cup of the top of the shank 14. Some elastic washers 17 are installed between the head 16 of the screw 15 and the sensor 13. This screw 15 allows height adjustment of the sensor 13 with respect to the jack 6.

A small protective housing 18, secured to the rear of the sensor 13 by means of the screw 15 and its nuts, covers the rear of the sensor 13 and prevents accidental separation of the sensor 13 and the jack 6. For this purpose the housing 18 includes two lateral screws 19 that project internally and are inserted in an annular opening 20 of the shank 14.

In its front part the sensor 13 is secured, by means of two screws 21 and 22, to an approximately horizontal plate 23 that is attached to the frame 3. One will note that the plate 23 includes two openings 24 and 25, traversed respectively by the two screws 21 and 22, which allows attachment of various sensors 13.

The sensor 13 has some strain gauges 26 with film type screen, preferably self-compensating with respect to temperature, arranged in some housings made on both sides of this sensor 13, at an intermediate point of its length. In the known manner these strain gauges 26 are part of a measurement bridge.

The strain gauges 26 are connected, by some electric conductors 27, to an electronic measurement circuit 28 installed in the upper part of the frame 3, above the front part of the force sensor 13. A

cell or battery **29** supplies the measurement device **12** with electric power. Finally, the electronic measurement circuit **28** has above it a display unit **30**, visible through an opening or window made at the top of the frame **3**. /8

The sensor **13** functions as a shearing stress sensor, allowing the measurement of a force as soon as the jack **6** is actuated to raise a load **31** that rests on the longitudinal bars **1** and **2**, is proportional to the weight **P** of the load **31**. The electronic measurement circuit **28** determines the numerical value of the weight **P** of the load **31**, which is registered on the display unit **30**.

The electronic measurement circuit **28** lets one consider a tare, known or unknown.

Figure 4, which corresponds to one part of Fig. 3, illustrates a first variant of the weighing device **12**, which differs from the preceding form of implementation only by the connection devices between the top of the lift jack and the rear part of the force sensor **13**.

The lift jack **6** is extended here along its axis, at its top by a short shank **14** at the top of which a ball **32** is secured. The rear part of the sensor **13** is traversed here by an approximately vertical screw **15**, whose head **16** turned toward the bottom has a tapered gap **33**. The upper part of the ball **32** rests against the wall of the tapered gap **33**. The screw **15** is screwed into a threaded hole of the sensor **13**, or even (as shown in Fig. 5) in a threaded sleeve **34** that

is itself installed in a smooth hole of the sensor **13**, in order to allow height adjustment of this sensor **13** with respect to the jack **16**. As previously a small protective housing **18** is secured by means of the screw **15** and its nuts.

This variant allows one, even in the case of shock, to always /9 preserve the same application point of forces.

To this point we have considered a weighing device incorporated in the manufacture of a manual transfer pallet. Figures 5 and 6 show another variant, identical functionally to the preceding forms of implementation, but comprising a weighing device that is adaptable to an existing manual transfer pallet.

This variant consists in a compact unit **35** that combines a force sensor **13**, a housing **36** that surrounds partially the force sensor **13**, and a box **37** installed above the housing **36** and incorporating the electronic measurement circuit, the integrated power supply and the display **30**.

The adaptation of unit **35** on the transfer pallet is done by sectioning, along line **38**, the existing head **39** of the frame **3** of the transfer pallet, then in fixing the front part of the force sensor **13** and the housing **36** on the remaining part of this head **39** by means of screws **21** and **22**, similar to those visible on Fig. 3. As for the rear part of the sensor **13** it is provided with a vertical hole and will be connected at the top of the lift jack **6** by some devices such as those described earlier with reference to Figs. 3 and 4.

While all the preceding examples pertain to weighing devices more particularly adapted to manual transfer pallets, Fig. 7 shows the possibility of application of the invention to a motorized pallet, especially an electric transfer pallet. The top of the lift jack **6** is here connected by a transverse shaft **40** held by means of two linchpins **41**, in the upper part **42** of the frame **3** of the transfer pallet, such shaft **40** being necessary because of the forces to be transmitted and possible shocks to be absorbed. For the measurement one provides here some strain gauges (not shown) that work in shear and are carried by the connection shaft **40**, which thus becomes a /10 dynamometer shaft.

As is apparent the invention is not limited to only the forms of execution of this weighing device on a manual transfer pallet that have been shown earlier as examples; on the contrary, it includes all the variants of implementation and application that utilize the same principle. Thus, one does not go beyond the scope of the invention by some modifications of the details, by providing for example a single housing that integrates the display and covers the top of the lift jack, or by adapting the same weighing device to transfer pallets for which some structural characteristics would differ from the examples shown in the drawing.

CLAIMS /11

1. Weighing device (12) on a transfer pallet, allowing one to determine and to indicate the weight (P) of a load (31) supported by

the pallet, which includes some longitudinal bars or "forks" (1,2) connected at the rear by a transverse frame (3), and a hydraulic lifting device with a hydraulic jack (6) with approximately vertical axis, connected to the said frame (3), characterized in that it includes at least one force sensor (13, 40) with strain gauges (26), which function as shearing force sensor, which also comprises a connection member between the top (14) of the hydraulic lift jack (6) and another part of the force sensor (13) being connected mechanically to the frame (3), this force sensor (13) being also connected electrically to an electronic processing unit (28) combined with some display devices (30) of the measured weight (P).

2. Weighing device according to Claim 1 characterized in that the rear part of the force sensor (13), shaped as a module oriented from rear to front, is connected by a ball and socket joint (16) at the top (14) of the hydraulic lift jack (6) while the front part of the force sensor (13) is integrated with the frame (3) of the pallet.

3. Weighing device according to Claim 2 characterized in that some devices (15) are provided for the height adjustment of the rear part of the force sensor (13) with respect to the top (14) of the hydraulic lift jack (6).

4. Weighing device according to Claim 3 characterized in that the rear part of the force sensor (13) is traversed by an adjustment screw (15), approximately vertical, whose head (16) turned toward the bottom has a spherical surface that comprises one of the components

of the ball and socket joint. /12

5. Weighing device according to Claim 3 characterized in that the rear part of the force sensor (13) is traversed by an adjustment screw (15), approximately vertical, whose head (16) turned toward the bottom has a tapered gap (33) against which a ball (32) secured in the top (14) of the lift jack (6) rests.

6. Weighing device according to any of the Claims 2 to 5 characterized in that a protective housing (18) covers the rear part of the force sensor (13) and the ball and socket joint (16) connecting this rear part at the top (14) of the hydraulic lift jack (6).

7. Weighing device according to Claim 6 characterized in that the protective housing (18) includes, laterally and internally, some projecting components (19) that are inserted in an annular opening (20) made at the top (14) of the hydraulic lift jack (6).

8. Weighing device according to any of the Claims 2 to 7 characterized in that the front part of the force sensor (13) is secured, by means of screws (21, 22) on an approximately horizontal plate (23) belonging to the frame (3), the plate (23) including some openings (24, 25) traversed by the screws (21, 22).

9. Weighing device according to any of the Claims 2 to 8 characterized in that the electronic processing unit (28) and the display devices (30), as well as the source of electric power (29) required for their functioning and for that of the strain gauges

(26), are arranged in the upper part of the frame (3) of the pallet, above the front part of the force sensor (13).

10. Weighing device according to any of the Claims 2 to 8 characterized in that the force sensor (13) is integrated with a compact unit (35) that also includes the processing electronics /13 (28), the display devices (30) and the electric power source (29), the said unit (35) being provided to be secured on the part left in place of the partially sectioned head (39) (at 38) of the frame (3) of an existing pallet, and to be connected to the tope of the lift jack (6) of this pallet.

11. Weighing device according to any of the Claims 2 to 10 characterized in that the force sensor (13) has some strain gauges (26) with film screen, arranged in some housings made on both sides of the sensor (13), at an intermediate point of its length.

12. Weighing device according to Claim 1 characterized in that the connection member between the top of the lift jack (6) and the frame (3) of the pallet, the member comprising also the force sensor, is a transverse connection shaft (40), shaped as a dynamometer shaft with strain gauges.

13. Weighing device according to Claim 12 characterized by its application to a motorized pallet, especially an electrically powered pallet.

FIG1

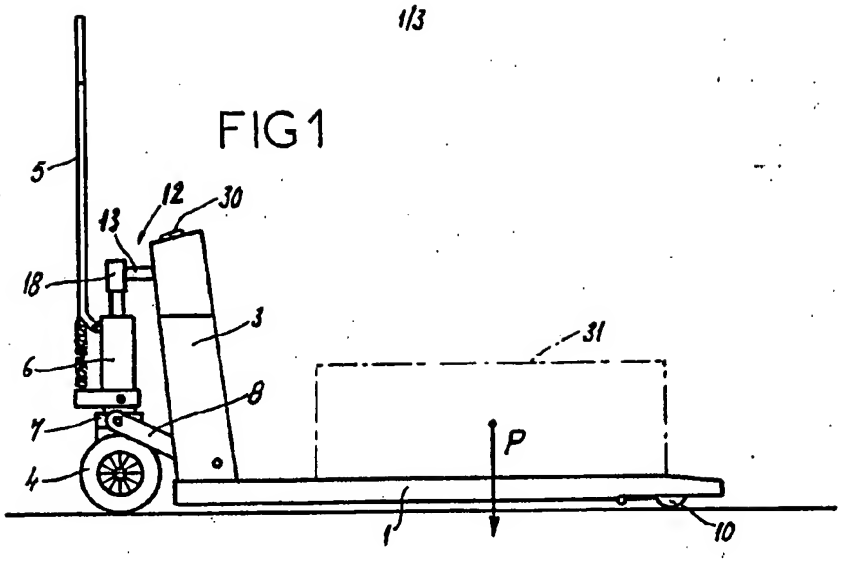


FIG2

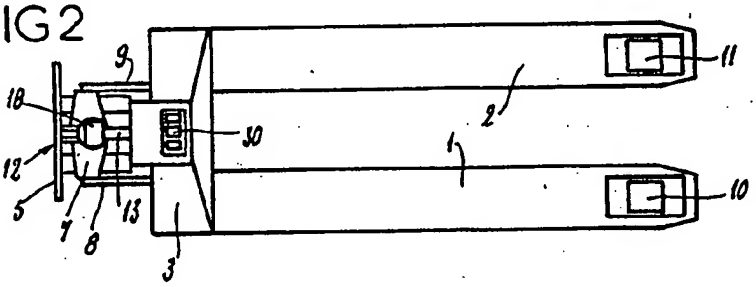


FIG3

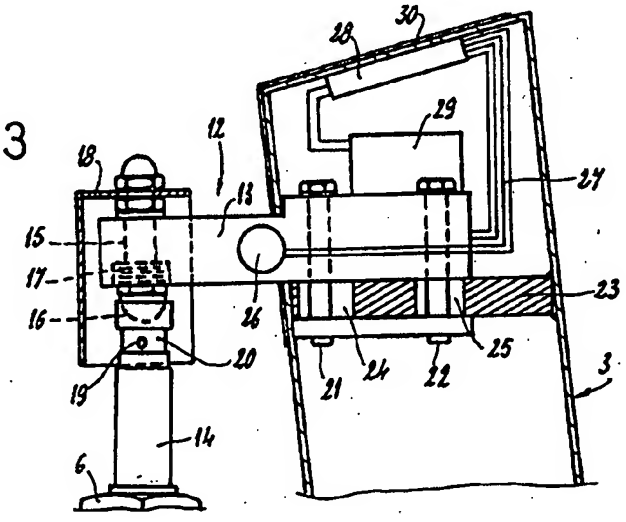
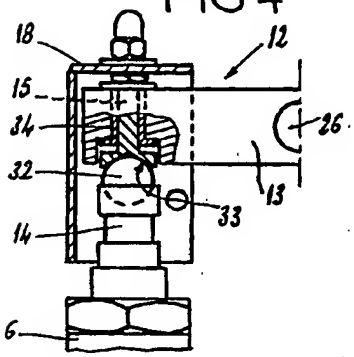


FIG 4



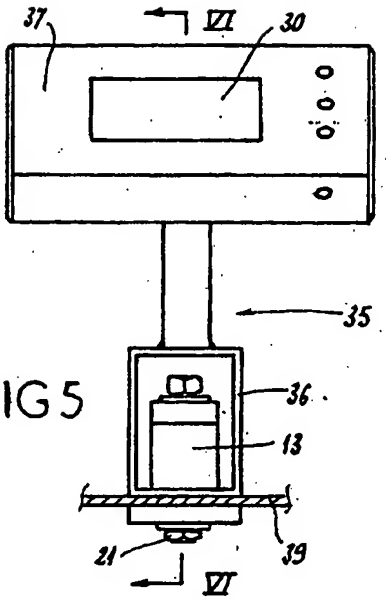


FIG 5

FIG 6

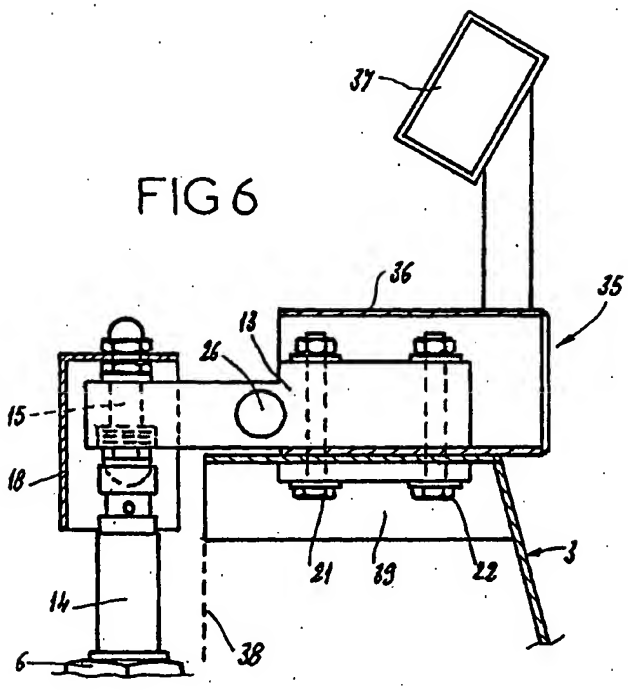


FIG 7